QUANTITATIVE PATHWAY ANALYSIS: The Risk of Karnal Bunt Introduction as a Result of the Importation of U.S. Wheat for Grain with Global Deregulation

Glenn Fowler
Risk Analyst
USDA-APHIS-PPQ-CPHST-PERAL
Raleigh, NC

Ron Sequeira
National Science Program Leader for Risk Analysis
USDA-APHIS-PPQ-CPHST
Raleigh, NC

Purpose

- To generate a quantitative model that estimates the risk of introducing KB into global wheat growing regions as a result of the importation of U.S. wheat for grain if there is deregulation
- To provide information that can be used in dialogues regarding the future direction of KB regulation

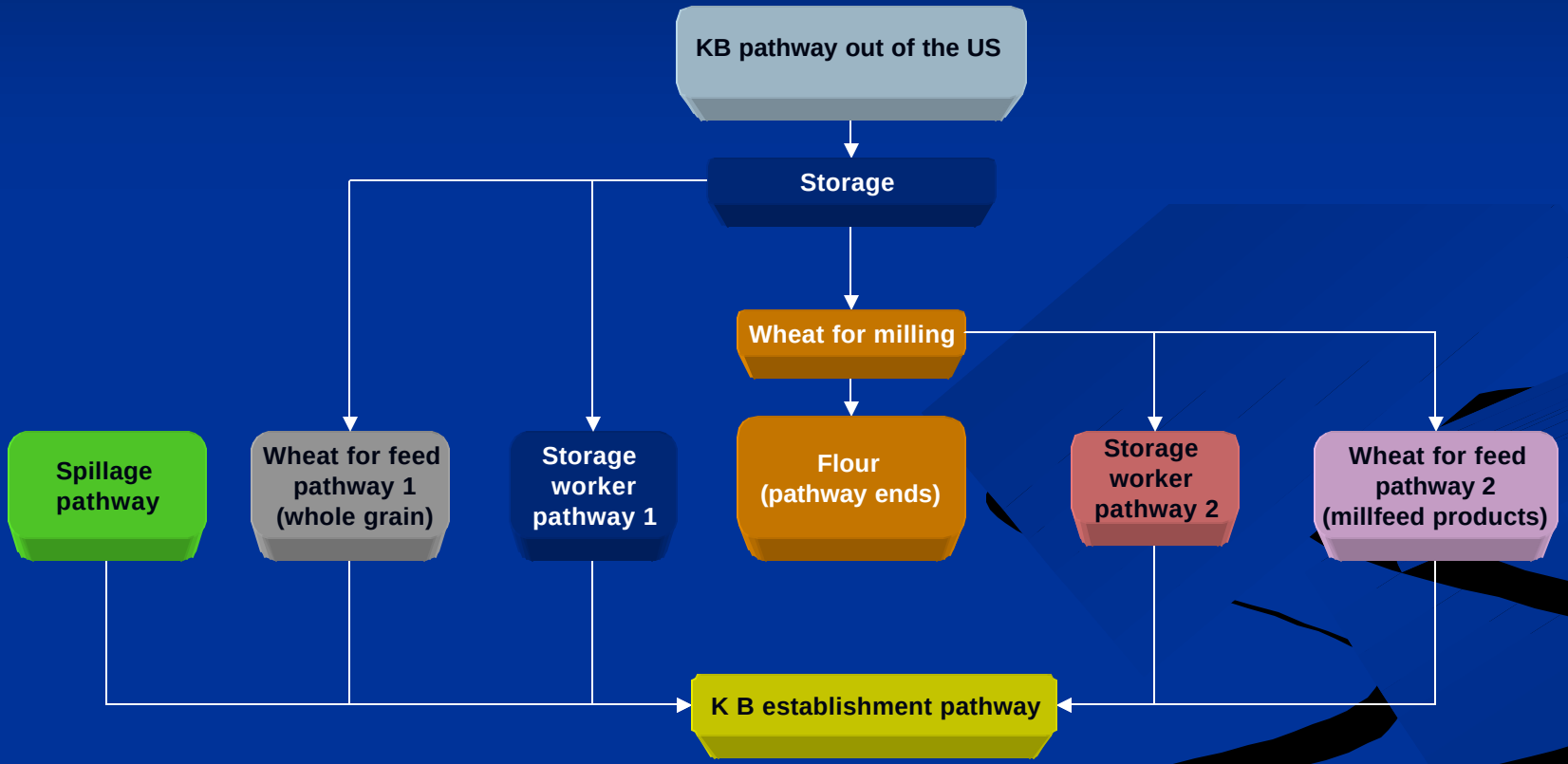
Characteristics of the Model

- Is constructed of nodes that track KB through the export/import process
- Is dynamic and can be modified to model an individual country's characteristics or to estimate general risk for the introduction of KB into a country

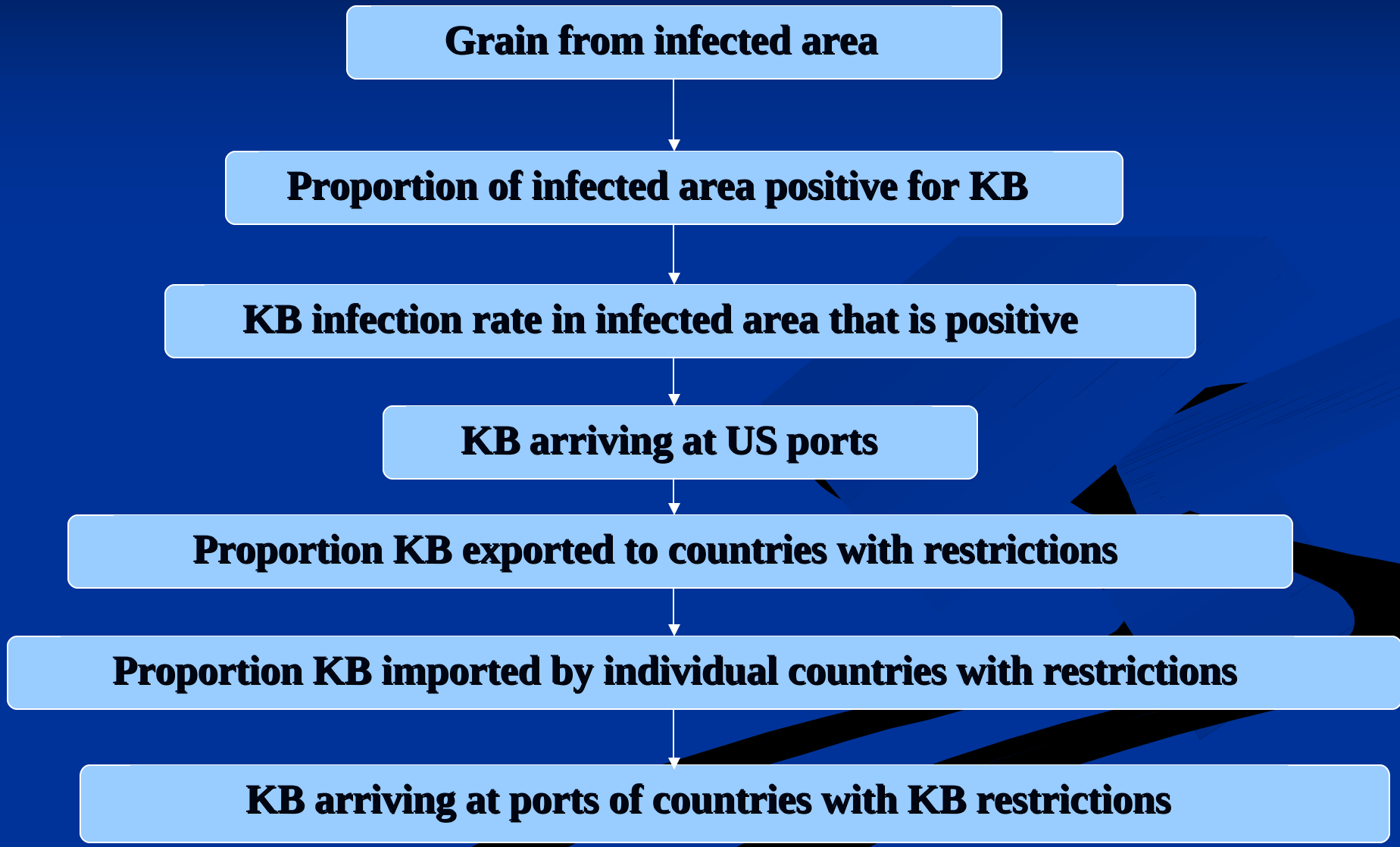
Methods Used to Construct the Model

- Nodes were estimated using scientific, technical, economic and/or agricultural sources
- Quantitative modeling software was used
- Allows for the entry of distributions, histograms, probabilities and/or Boolean operators
- 10,000 iterations of the model were performed

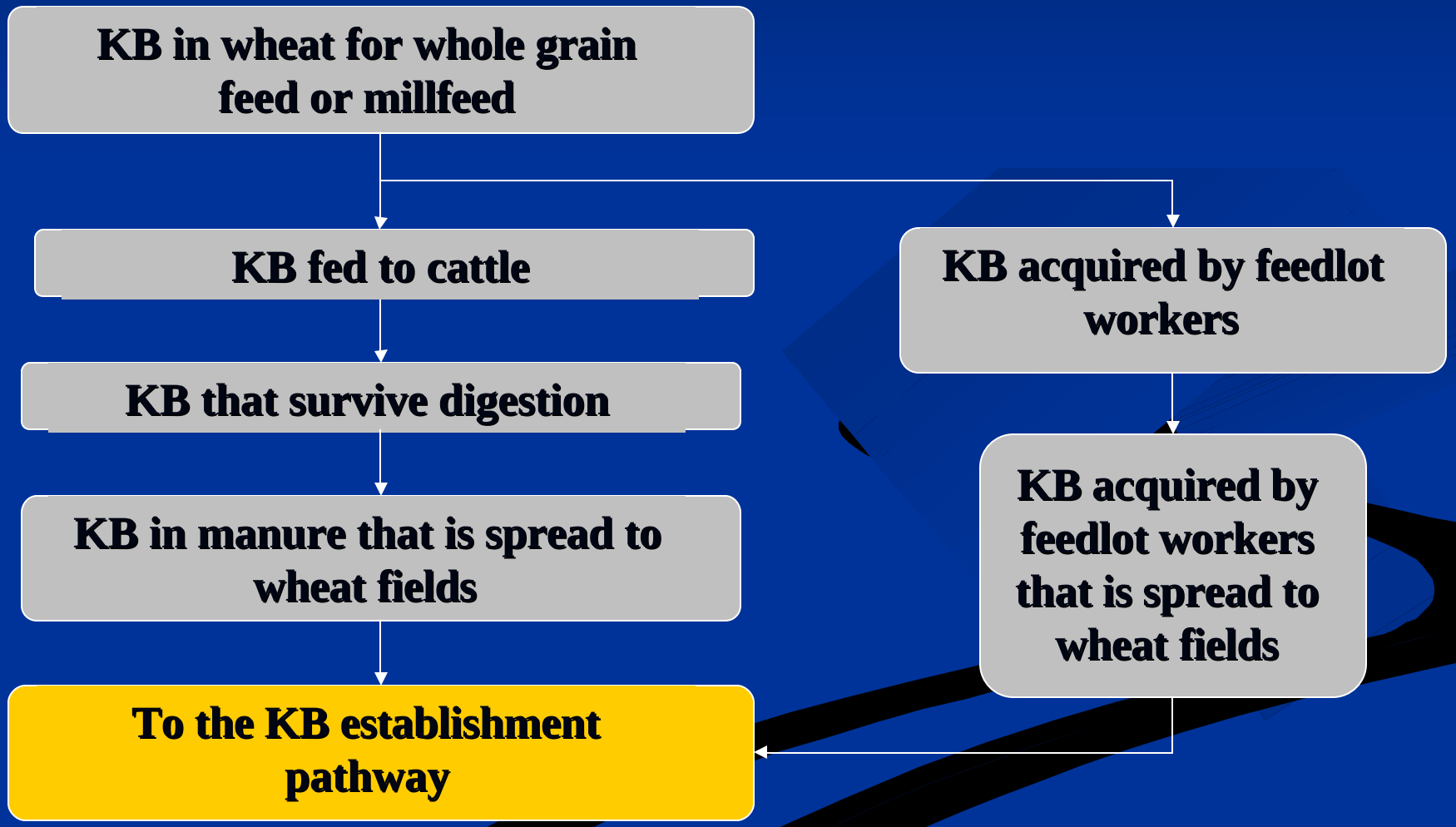
Pathway Overview



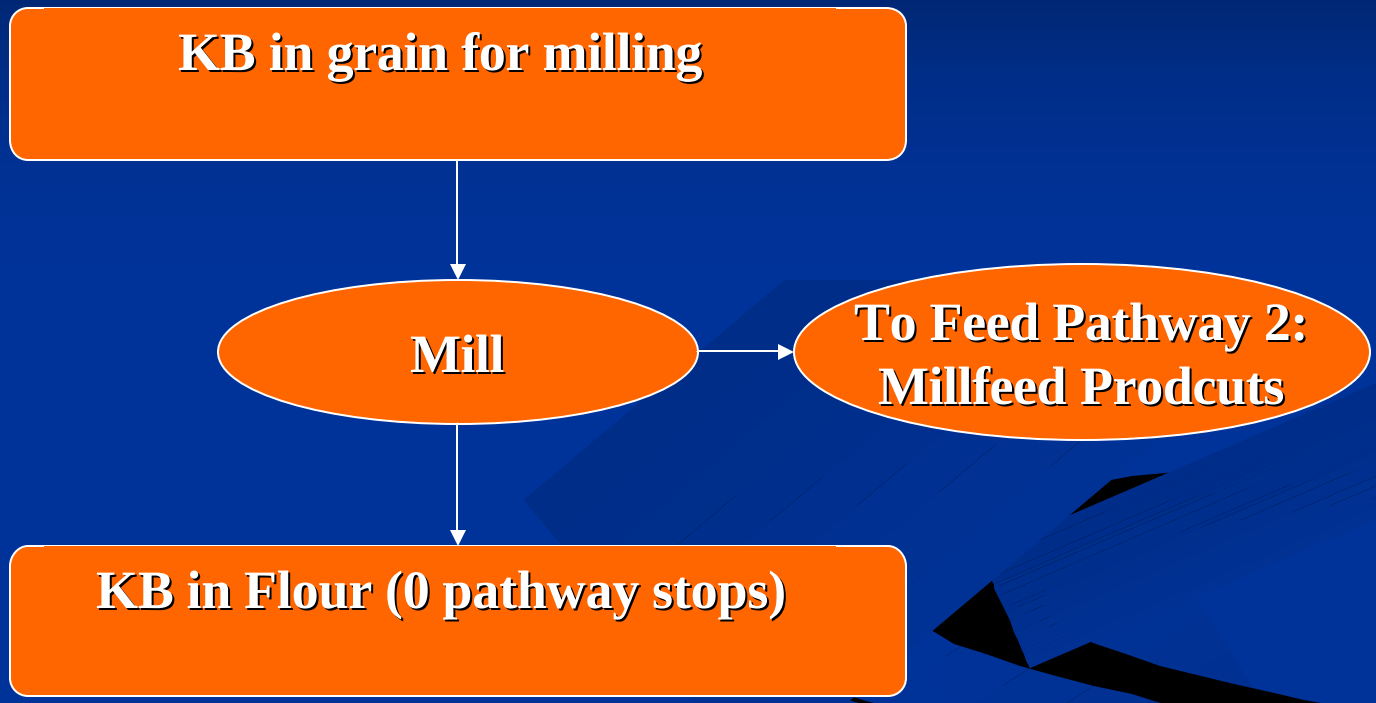
KB Pathway out of the U.S.



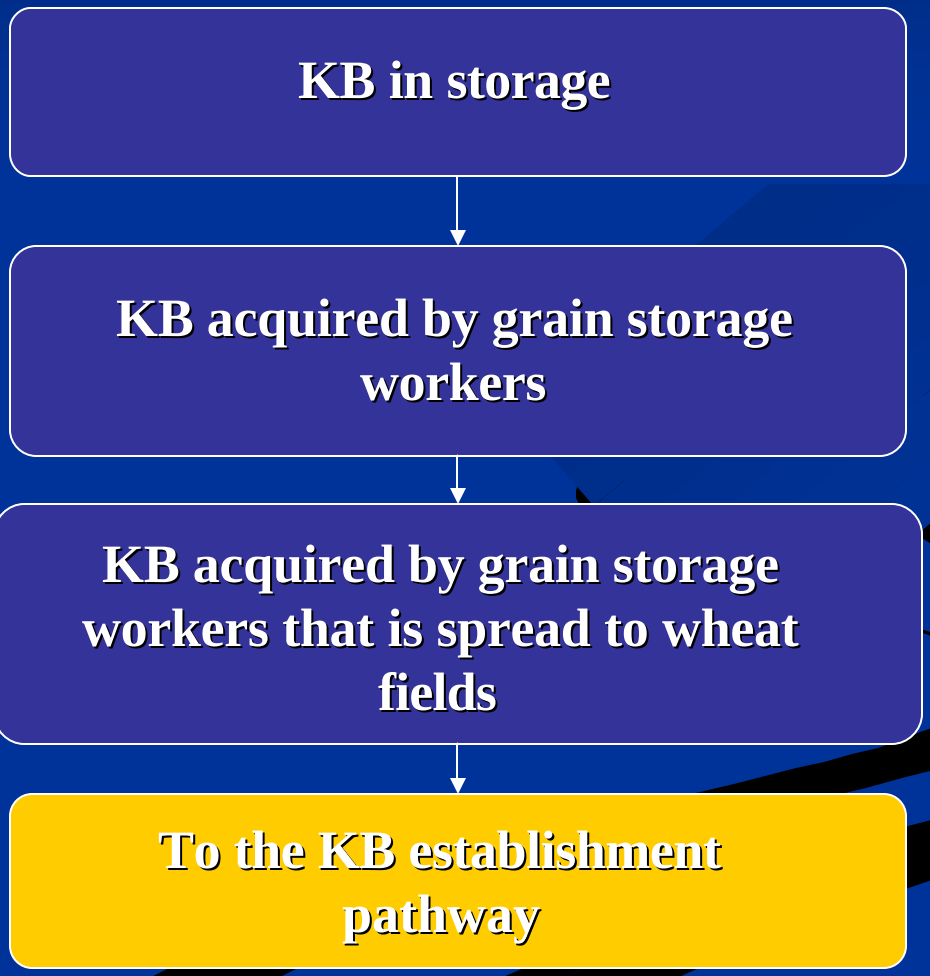
Wheat for Feed Pathways 1 and 2: Whole Grain and Millfeed Products



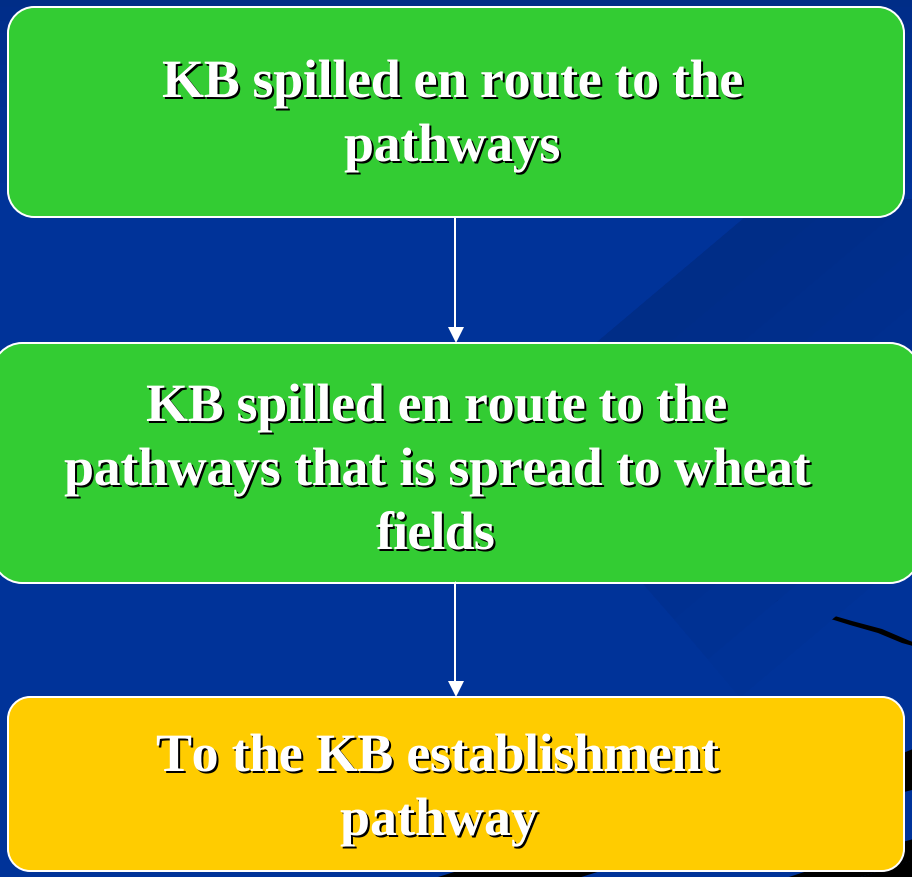
Wheat for Flour Pathway



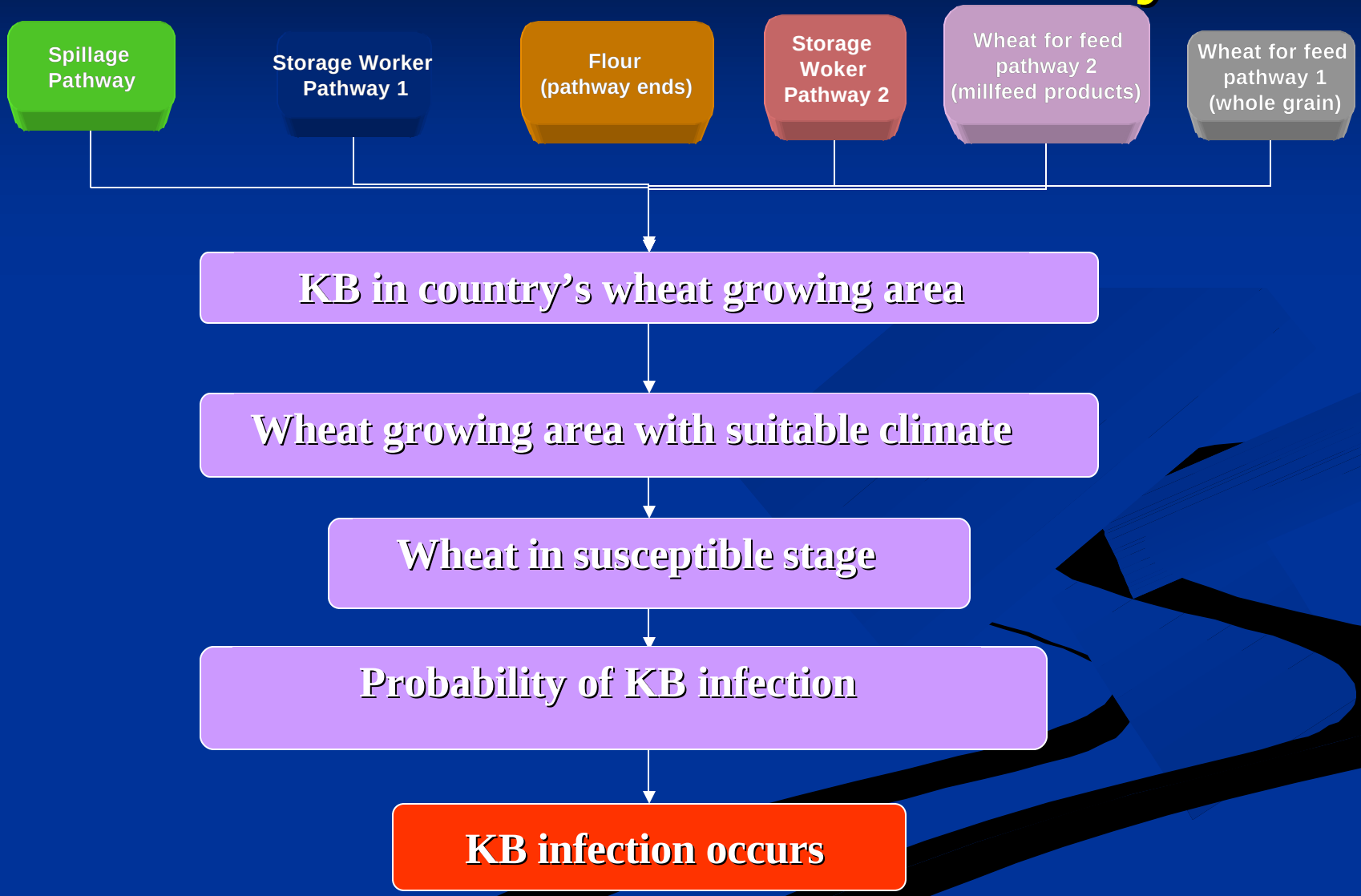
Storage Worker Pathways 1 and 2: After Arrival in Country and After Milling

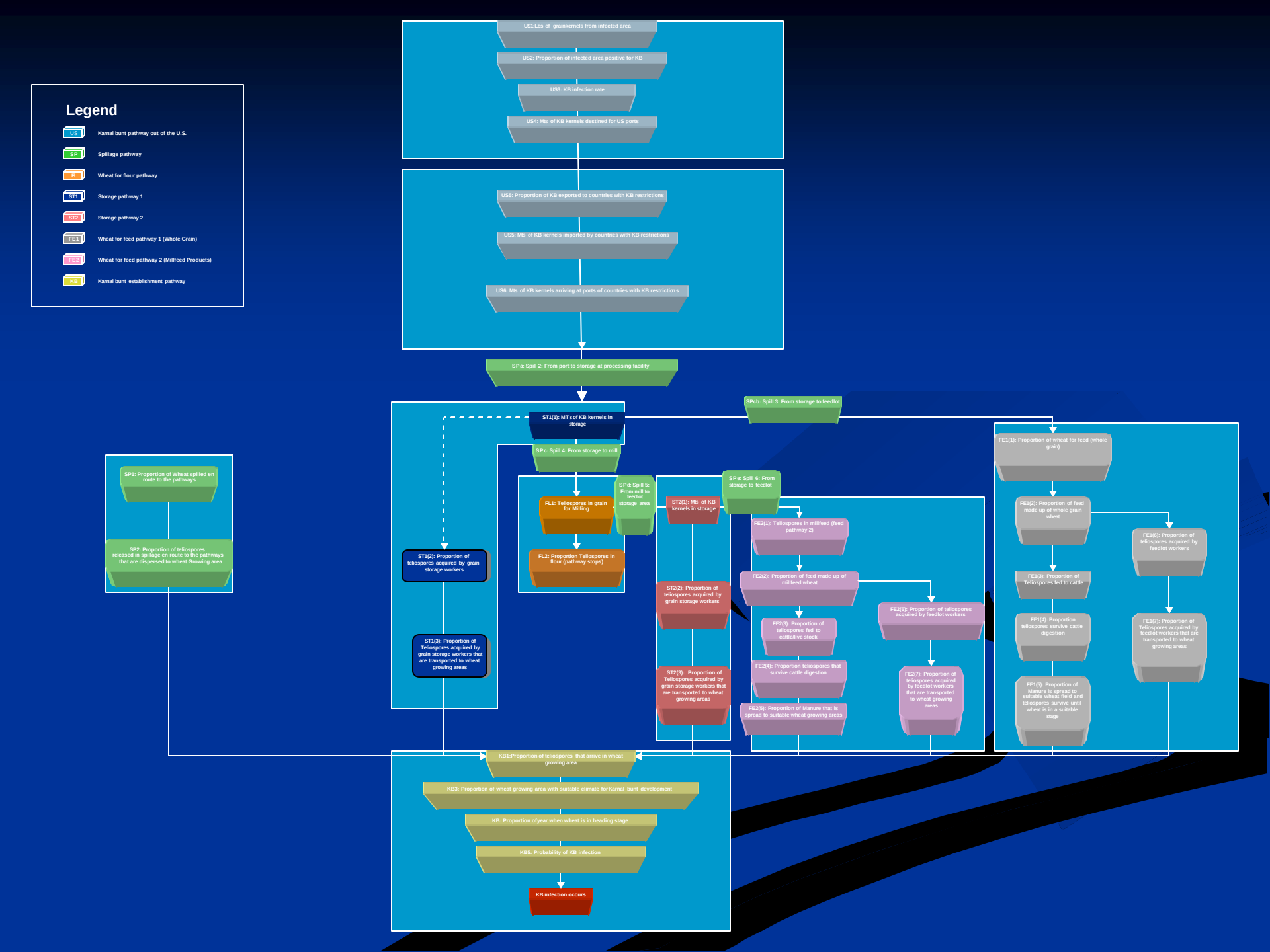


Wheat Spillage Pathway



KB Establishment Pathway




Legend
US
Karnal bunt pathway out of the U.S.
SP
Spillage pathway
FL
Wheat for flour pathway
ST1
Storage pathway 1
ST2
Storage pathway 2
FE1
Wheat for feed pathway 1 (Whole Grain)
FE2
Wheat for feed pathway 2 (Millfeed Products)
KB
Karnal bunt establishment pathway
US1:Lbs of grainkernels from infected area
US2: Proportion of infected area positive for KB
US3: KB infection rate
US4: Mts of KB kernels destined for US ports
US5: Proportion of KB exported to countries with KB restrictions
US5: Mts of KB kernels imported by countries with KB restrictions
US6: Mts of KB kernels arriving at ports of countries with KB restrictions
SP1: Proportion of Wheat spilled en route to the pathways
SP2: Proportion of teliospores released in spillage en route to the pathways that are dispersed to wheat Growing area
SPa: Spill 2: From port to storage at processing facility
SPcb: Spill 3: From storage to feedlot
ST1(1): MTs of KB kernels in storage
SPc: Spill 4: From storage to mill
SPd: Spill 5: From mill to feedlot storage area
SPe: Spill 6: From storage to feedlot
FL1: Teliospores in grain for Milling
FL2: Proportion Teliospores in flour (pathway stops)
ST1(2): Proportion of teliospores acquired by grain storage workers
ST1(3): Proportion of Teliospores acquired by grain storage workers that are transported to wheat growing areas
ST2(1): Mts of KB kernels in storage
ST2(2): Proportion of teliospores acquired by grain storage workers
ST2(3): Proportion of Teliospores acquired by grain storage workers that are transported to wheat growing areas
FE2(1): Teliospores in millfeed (feed pathway 2)
FE2(2): Proportion of feed made up of millfeed wheat
FE2(3): Proportion of teliospores fed to cattellive stock
FE2(4): Proportion teliospores that survive cattle digestion
FE2(5): Proportion of Manure that is spread to suitable wheat growing areas
FE2(6): Proportion of teliospores acquired by feedlot workers
FE2(7): Proportion of teliospores acquired by feedlot workers that are transported to wheat growing areas
FE1(1): Proportion of wheat for feed (whole grain)
FE1(2): Proportion of feed made up of whole grain wheat
FE1(3): Proportion of Teliospores fed to cattle
FE1(4): Proportion teliospores survive cattle digestion
FE1(5): Proportion of Manure is spread to suitable wheat field and teliospores survive until wheat is in a suitable stage
FE1(6): Proportion of teliospores acquired by feedlot workers
FE1(7): Proportion of Teliospores acquired by feedlot workers that are transported to wheat growing areas
KB1:Proportion of teliospores that arrive in wheat growing area
KB3: Proportion of wheat growing area with suitable climate forKarnal bunt development
KB: Proportion ofyear when wheat is in heading stage
KB5: Probability of KB infection
KB infection occurs

Status of the Pathway Analysis Model

- Draft version has undergone internal review by KB and modeling experts in ARS and APHIS
- The next round of review will include academia and industry
- The model will be distributed to the NAPPO grains panel

Conclusions

- The model outputs minimum, mean, maximum and confidence intervals for the probability of KB establishment with global deregulation
- The model identifies sub-pathways that pose the greatest risk for facilitating KB establishment
- The model is dynamic and can provide estimates of risk for specific countries
- The model is part of the strategic plan for deregulating KB as a quarantine disease